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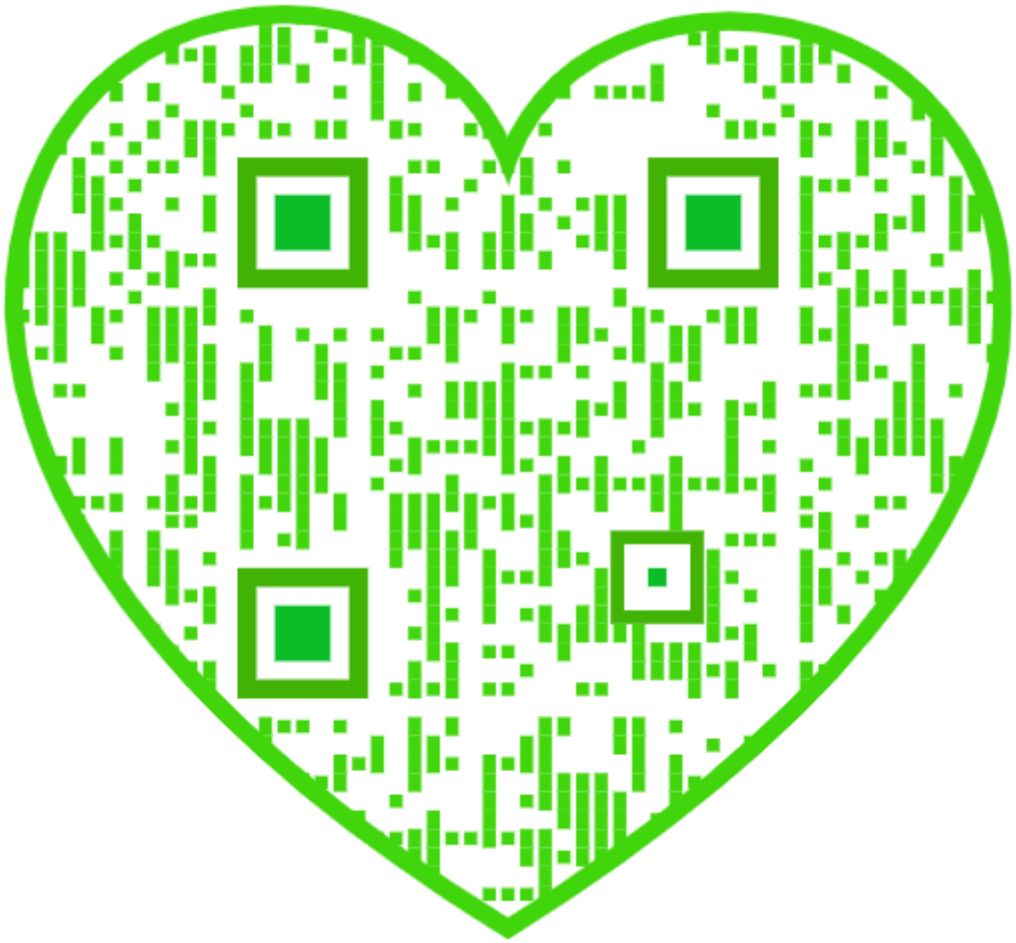

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

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ENTOMOLOGICAL SERIES, No. 25

BEEKEEPING FOR CONNECTICUT

By A. W. YATES

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BEEKEEPING FOR CONNECTICUT.

By A. W. Yates.

Introduction.

Beekeeping is a possible source of both pleasure and profit requiring a small amount of attention. Honey has considerable value as food, and in these days of food conservation and shortage of sugar, its value is correspondingly greater than in normal times. Beeswax is also valuable and both honey and wax find a ready market. Beekeeping has never been properly developed in Connecticut. There are many beekeepers, each with a few colonies, but in most cases the bees are left to shift for themselves. There is need of more bees in the hands of energetic beekeepers, who will give them more intelligent care.

The outlook for honey production never was better, from the money standpoint, than at present, and the possibilities, through the suppression and control of infectious diseases, are much greater in recent years; therefore it is hoped that this bulletin, while not complete or by any means final, may encourage more people to keep bees, and induce those who already have them to give them better care, so that beekeeping and honey production generally will be much improved. Bees on the farm, if rightly managed, will prove very often the best paying investment the farmer has for the amount of capital and time expended, and farmers who become interested in apiculture will often find that the profits far exceed their expectations. Bees not only are valuable as honey producers but are of great value as pollen carriers, fertilizing a great many fruit and vegetable crops, thus increasing their productiveness.

The sting, no doubt, is the reason why beekeeping is not more popular. This, however, can be almost entirely avoided by the use of the smoker and veil, and by the keeping of races of bees that are less prone to stinging. Of course, all honey-gathering bees have stings and will use them when aroused, but some races, such as the Italians and Carniolans, are much less given to using them.

Almost any persons, except those of a nervous temperament, can keep bees if they desire. Although there are many hundreds of beekeepers in the state, only a very small percentage make apiculture their sole occupation. There are locations, without doubt, where an experienced beekeeper would be well paid for devoting his whole time to the pursuit. Almost any location in

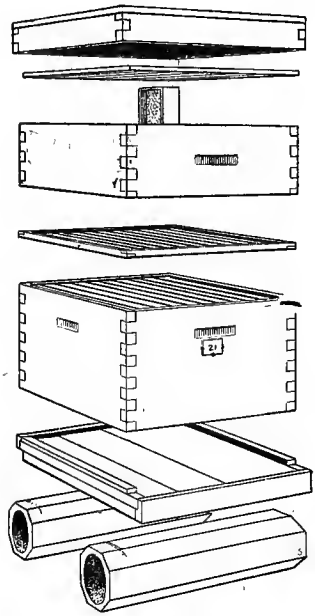


Figure 5. A ten-frame hive with comb-honey super and perforated zinc queen excluder. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

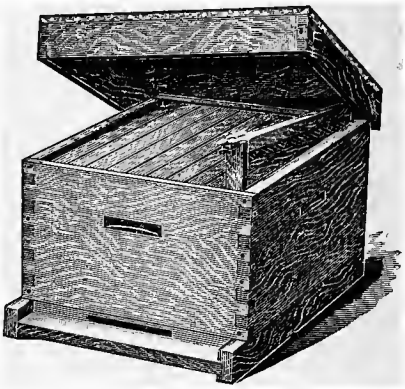


Figure 6. One-story Standard hive with metal cover. (After the A. I. Root Co.)

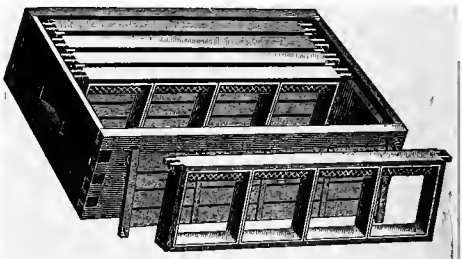


Figure 7. New Special section-frame super. (After the A. I. Root Co.)

the state would support a few colonies with profit to their owner. Backyards in cities and villages, or barren places in the country, could be utilized for this purpose with surprising results.

Beekeeping is also popular with invalids and people of sedentary habits, affording them mental relief and healthful, outdoor exercise. The apiary inspectors of this department are always ready to give instruction or information to those desiring it. One or more of

the text books or pamphlets listed in the back of this bulletin will be found helpful.

The hives and accessories illustrated and described in the following pages are such as have been tested by practical beekeepers and can be recommended to the beginner.

He must remember, however, that beekeeping is no "get-rich-quick" scheme. To succeed and to secure a crop of honey requires work, and work at the right time. A little delay at such times may spell failure. Poor seasons intervene when colonies will have to be fed to take them through the winter and it may need a good deal of enthusiasm on the part of the beekeeper to keep up his courage. These seasons, however, do not occur very often and the practical beekeeper knows that he must make the best of them.

Hives.

Before starting beekeeping it is well to decide on the style of hives to be used and some other necessary equipment. The bees are as contented in an old box or tub as in the best modern hive, but for economical production of honey a carefully made hive is essential. Below are described two of the most popular kinds.

THE STANDARD OR LANGSTROTH HIVE.

This is the regular standard hive used by nearly all practical beekeepers and shown in figure 6. A more thorough description is given in supply catalogs. The hive consists of a bottom board, the brood chamber or living quarters, which is a box containing either eight or ten movable frames, and a cover. This hive, less a few minor improvements, was invented in 1851 by the Rev. L. L. Langstroth and is sometimes called the Langstroth hive. It was his knowledge of the peculiarities of the bee that enabled him to invent a hive that revolutionized beekeeping. All other movable frame hives are but modifications of this, though some of them are but poor substitutes.

It is usually better for the beekeeper to buy his hives in the flat, nailing them together himself, rather than to try to make them, especially if he values his time at anything. Factory-made hives are made with great accuracy.

This hive being adopted as the standard, it is very reasonable to suppose that it combines within itself more good qualities than any other and should therefore have the preference.

THE SUPER.

Above this standard hive and beneath the cover, is placed a shallow box or frame holding the comb-honey sections and called a "super." The super is shown in figures 7–10, and is the storeroom of the hive, in which the bees place their surplus honey. Often several supers are placed on one hive.

These supers may be used for either comb or extracted honey, and are each fitted out differently with inside fixtures, the extracting supers having frames similar to those of the brood chamber, only much shallower. These are also used in the sectional brood chamber hive described on page 429. The section box super is provided with section holders or forms to hold the delicate section boxes.

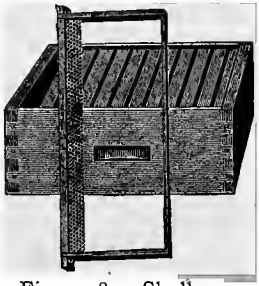


Figure 8. Shallow extracting super. (After the A. I. Root Co.)

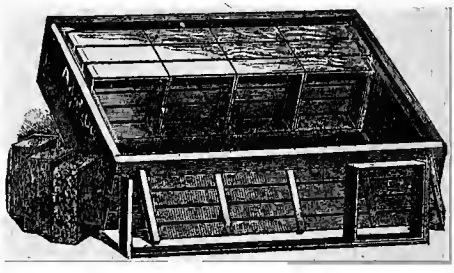


Figure 9. Plain section super. (After the A. I. Root Co.)

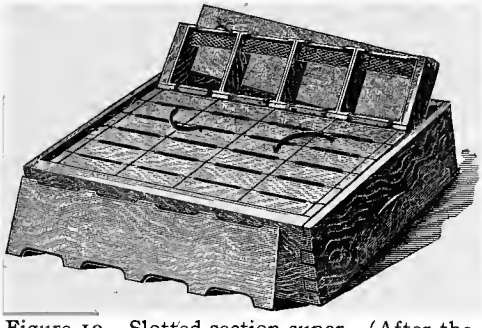


Figure 10. Slotted section super. (After the A. I. Root Co.)

The slotted section super is the oldest and there are probably more of them in use at present among beekeepers than any other, but they are slowly being discarded for those of later design. One important point in the construction of a super is simplicity. The more parts there are, the more time it takes to keep them cleaned of propolis, a gummy substance that the bees use to cover cracks in the hive. This must all be scraped off each time a super is

emptied so that the parts will go together again. The super most highly recommended by the writer is what is known as the N. section frame super, shown in figure 7.

This super, as the name implies, is fitted with eight section frames holding four section boxes each with the ten-frame hive, or seven with the eight-frame hive. The frames are separated by fences, as is shown in the illustration above. These frames not only serve to hold the section boxes square, but by covering them completely protect them from stains and propolis that are always present when the open top styles are used.

THE FRAME.

The frame most commonly used with these hives is what is known as the Hoffman self-spacing, shown in figure 11. This is built in two sizes, one being 9 1-8 inches deep for the regular hive; the other 5 3-8 inches deep for the shallow hive or super. These are suspended separately so that the beekeeper may be able to take a hive of bees entirely apart if he desires. The person who has a modern hive and does not avail himself of the advantages it permits may as well go back to the old box hive of his grandfather.

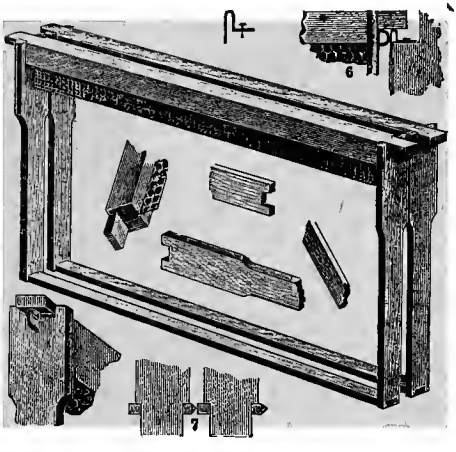


Figure 11. The Hoffman frame. (After the A. I. Root Co.)

THE SECTIONAL BROOD CHAMBER HIVE.

Another hive highly recommended by the author, especially in the production of comb honey, is what is called the sectional brood chamber hive, shown in figure 12. This is built up with two or more units of extracting supers, such as are used with the Standard in the production of liquid honey. This hive is especially adapted to localities like our own, where the honey flow is of short duration

and rapid work in the super is required. It also makes an ideal brood chamber for wintering. The opening between the two sets of frames forms a passage for the bees to pass, during extreme cold weather, to get to fresh winter stores, without going over, under, or around the combs through the cold extremities of the hive; supers and brood chamber units are interchangeable; colonies are easier and better kept under control during the swarming season; it is easy to make increase when desired simply by removing one unit and supplying it with a queen; and a strong colony is always ready for the super when desired by simply removing all but one unit of the brood chamber. Beekeepers often ask, "How can I get my bees to work in the super?" The sectional hive solves the problem. It puts the honey in the super. Yes, all the honey.

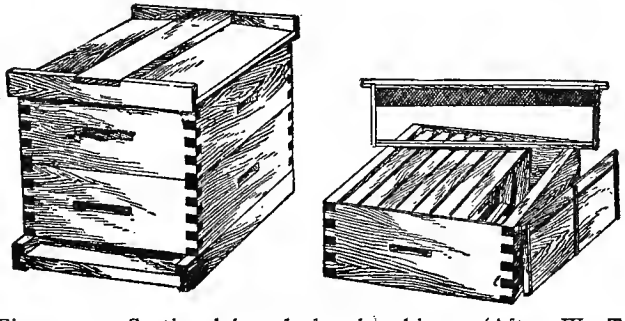


Figure 12. Sectional brood chamber hive. (After W. T. Falconer Mfg. Co.)

A queen excluder (see figure 13) should always be used between the brood chamber and super of this hive; otherwise the queen in her restricted quarters would go above to lay and it is desirable to keep brood and surplus honey separated. This hive might be termed a specialist's hive but it can be easily managed by an amateur. Both of the above hives are built in two sizes, for eight or ten frames. The ten-frame size is the one most commonly used by experienced beekeepers so that it is safe to decide that this is the best adapted for all purposes.

The beginner will make no mistake in selecting either of the hives or supers described above. The amateur who keeps only a few hives will readily decide to work for comb honey, because this will not require an expensive extractor and nice white combs of section honey will appeal to him. For this purpose the sectional

hive is worthy of consideration. All hives or parts should be alike so as to be interchangeable. There probably is no worse nuisance in an apiary than several different styles and shapes of hives and supers.

Smokers.

The smoker (see figure 14) is indispensable while handling bees. It is made of tin or copper and is provided with a bellows to drive the smoke and keep the fire going. Old cotton rags, waste or rotten wood are used for fuel. Blow a little smoke in at the entrance before opening the hive. Give the bees a little more while uncovering the frames; if very cross, repeat the dose, until they yield; then they may be handled safely. Handle them gently, avoiding all quick motions.

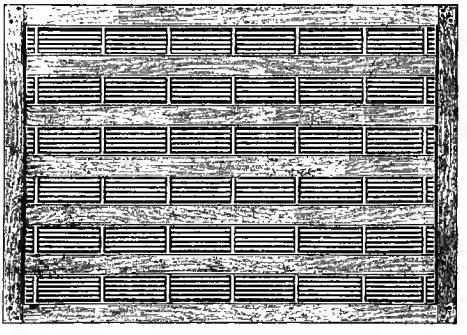


Figure 13. Wood-and-wire queen-excluding board, with seven-wire strips. (After the A. I. Root Co.)

Figure 14. Junior Smoker. (After the A. I. Root Co.)

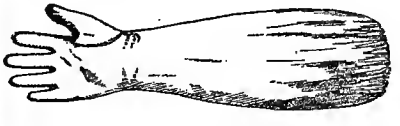


Figure 15. Bee-glove with fingers. (After the A. I. Root Co.)

Figure 16. The Alexander bee veil. (After the A. I. Root Co.)

Veils.

In addition to the smoker, a veil is necessary for the beginner, and possibly gloves for the hands. It is foolish for the novice to undertake to handle bees without proper protection. One type of veil is shown in figure 16 and a glove in figure 15.

Hive Tool.

Some kind of a hive tool is a necessity. The one illustrated in figure 17 is excellent, though a screwdriver will do.

Comb Foundation.

The comb foundation is a thin sheet of pure beeswax, shown in figure 18, embossed to imitate the base or septum of the natural built comb. The use of this is almost indispensable in securing straight worker brood combs. For economy some beekeepers use only starters, which are narrow strips about one inch wide. This results in the building by the bees of a considerable amount of undesirable drone comb. Later, when this is occupied by the queen, sometimes multitudes of useless drones emerge, which are consumers instead of producers. Three workers or producers can be hatched from the same comb surface that is occupied by two drone cells; therefore it is evident that the full sheets of foundation are cheapest in the end. The use of full sheets is further demonstrated when it is remembered that it takes from fifteen to twenty pounds of honey to produce one pound of wax, and the comb must be built before it can be used for storing honey or brood.

Figure 17. Nickeled-steel hive-tool. (After the A. I. Root Co.)

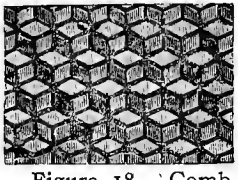


Figure 18. Comb foundation. (After the A. I. Root Co.)

Stocking with Bees.

After getting the hive ready, the next thing is to have it stocked with bees. As a general rule it is best, if possible, to buy good-sized first swarms as they issue during early May. These can usually be procured locally for about three dollars. One great advantage in securing bees in this way is the freedom of any danger of brood diseases which might be found in a colony with combs. Brood diseases are dangerous for the veteran beekeeper but much more so for the beginner. Such a colony hived in a single-story standard hive will soon fill it with honey and brood and a super should be furnished so that all surplus may be stored; likewise with the sectional hive, a single unit is used and a super of section boxes is put on immediately with the excluder between. It is possible and even probable that this may be followed with another one week later, if the honey flow continues. A second unit of brood chamber, however, should be added in sufficient time for the bees to stock it up for winter.

If swarms cannot be obtained in this way it is best to purchase from some reliable dealer. These may be obtained either in bulk, in nucleus, or in full colonies. Full colonies will sometimes produce enough the first season to pay for themselves, so that this usually is a very satisfactory way to buy, and the purchaser will have gentle, blooded stock to start with.

The Colony.

Every normal colony of bees in prosperous times is composed of three varieties of bees: the queen, or, more correctly speaking, the mother bee, that lays all the eggs (often as many as three thousand a day during the busy season); forty or fifty thousand

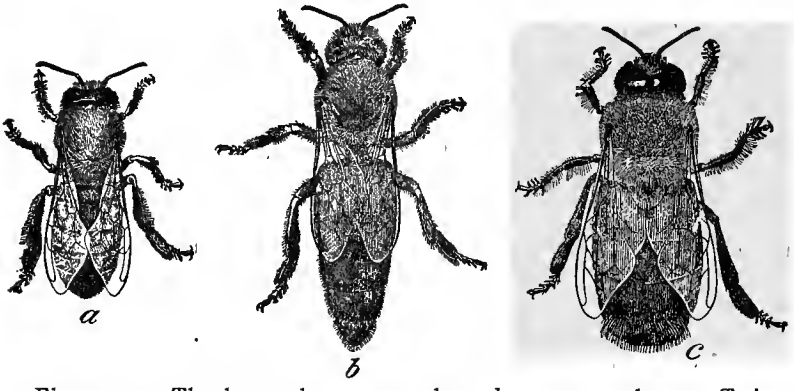


Figure 19. The honey bee: *a*, worker; *b*, queen; *c*, drone. Twice natural size. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

workers or undeveloped females; and a few hundred drones or male bees. The queen is the important factor in the success of the colony. Ancient writers called her the "King," and it was only within a few years that the error was discovered. Some queens are so prolific that the ordinary hive is too small to accommodate them, keeping it overflowing with bees and activity, while others are so inferior that their colonies make only a sickly effort to exist. The drone, queen and worker are shown in figure 19.

As has been mentioned, the combs are composed of two different sized cells. Eggs laid in the larger or drone cells always mature drones, while those laid in the smaller ones mature workers. The

queen cell is simply an elongated worker cell, resembling a peanut, drawn out over the comb. In case the colony needs a queen, any worker egg laid or placed in one of these cells will hatch into a larva, which will be lavishly fed with a thick, milky fluid and mature a queen. The queen usually passes the time of her greatest usefulness in her second year. For this reason a good many progressive beekeepers practice requeening at this time. Eggs are shown on plate XXXVI, c, and drone, queen and worker cells on plate XXXV, b.

Workers.

By far the most numerous bees in the hive are the workers. They are also the smallest, measuring only about one-half inch in length. Except laying the eggs, they do all the work about the hive—gathering the honey and pollen; building the combs; feeding and taking care of the brood; cleaning the hive, sealing all cracks and doing all other labor required. The life of the workers during the busy season is only about six weeks, in which time they wear out their wings flying against the wind or through the grass in the fields in search of food. For this reason grass should always be kept down in front of the hive entrance.

Drones.

The drones are the non-producers of the hive and live on the toil of the workers. They have no means of producing honey or secreting wax or doing even the work necessary for their own support. They are longer than the workers, shorter than the queen, but thicker and clumsier than either. Their wings reach to the tip of their body; and when they are on the wing they make much more noise. Their sole object is to mate with the young queens, which always happens on the wing. After the mating the drone dies immediately.

Races of Bees.

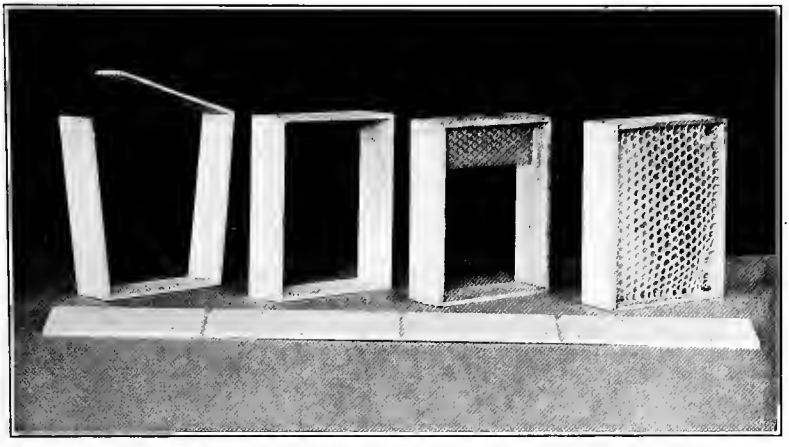
The black or German bee was the first brought to this country, some say by the Pilgrims; others, by way of Florida. These are a very hardy race and good honey gatherers, more especially adapted to the production of comb honey, but their irritable temper and inability to resist disease have brought them into disfavor.

Their cousins, the Banats, Carniolans and Caucasians, three other dark races, are gentle and good honey producers if they can

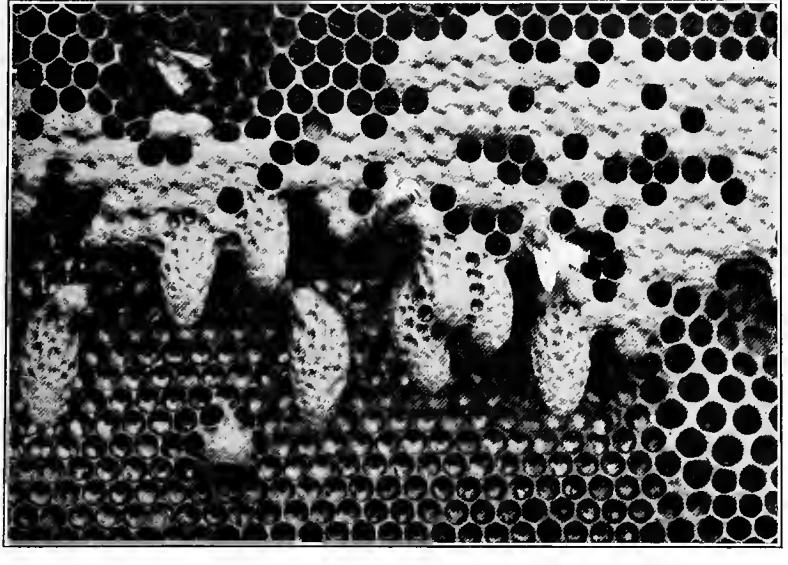
a. Mating and queen rearing apiary of A. W. Yates, Hartford.

b. View of apiary at Station farm, Mt. Carmel.

A standard hive opened showing brood frames: Mr. L. C. Root, Stamford, a veteran Connecticut beekeeper. (After Dr. E. F. Bigelow, Arcadia, Sound Beach, Conn.)

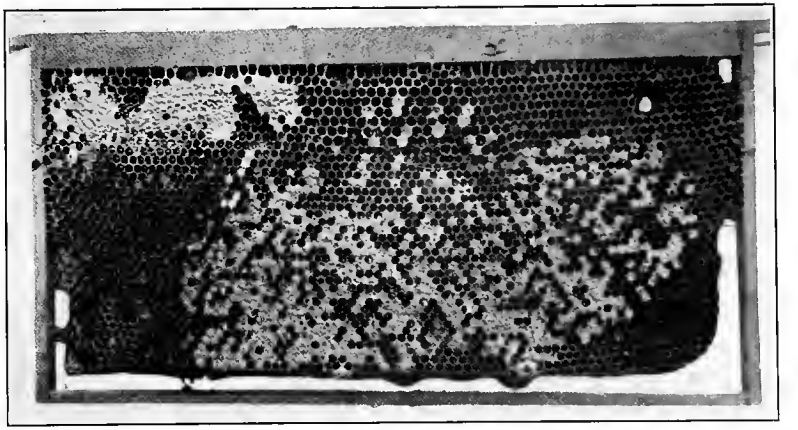


a. Section frames as used in the supers: in the flat, bent together, with foundation starter, and with drawn comb ready to receive the honey.

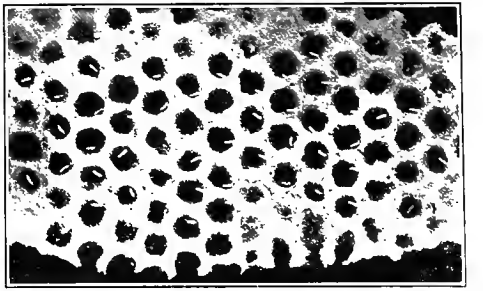


b. Close view of brood comb, showing open and capped cells: the large peanut-shaped cells are queen cells; the larger open cells near lower right hand corner are drone cells; others are worker cells. (After Dr. E. F. Bigelow, Arcadia, Sound Beach, Conn.)

c. A swarm just hived.



b. A frame of American foul brood.



be kept from swarming, but this is almost impossible. The Cyprians are energetic workers but also have bad tempers, which bar them from most apiaries.

The Italians, introduced into this country in the sixties, are the most popular among good beekeepers. They are good workers, and, as a rule, are as gentle to handle as any of the other races named. These qualities, together with their rich, golden color, and their ability to withstand some of the worst ravages of foul brood, make them the favorites of our beekeepers.

Location.

The needs of the bees are seldom considered in selecting a location. It is best to choose a sheltered spot, protected as much as possible from prevailing winds. The south side of a hedge, a high board fence or building, or a clearing in the woods, is good. Look out for air currents, such as circulate between two buildings. Have the hives face the south as near as convenient.

Swarm Control.

It requires a large force of bees in each hive to secure a crop of honey. The larger the force when the flow arrives, the better. The beekeeper with one hundred weak colonies would get scarcely any surplus, while the one with only twenty-five or fifty colonies of good strength would obtain good results. This crowded condition, however, is one of the primary causes of swarming, and it is advisable, as far as possible, to have no swarming during the honey flow. Some of the precautions taken for its prevention are the introduction of young queens some time previously; giving plenty of room by adding a super, and when this is partially full, if the prospects look good for the continuance of the flow, inserting another beneath the first; ventilating by giving full, wide entrance, or if the nights are very warm, raising the hive an inch from the bottom board. These methods, while precautionary to discourage swarming, are not preventive and it is advisable to examine every colony occasionally for symptoms, and if at any time it is found that queen cells are started, they should be cut out and a super of extracting combs given without the excluder. A week later, if no cells are started, this can be exchanged for a comb honey super. Should cells be started, however, remove the super, taking the

queen with it, and exchange places with the brood chamber, using this as a brood chamber. Put on a super of section boxes immediately and close the hive. A portion of the bees in the old brood chamber should then be shaken in front of the new hive, leaving only enough to properly take care of the brood, or, if no increase is desired, all should be shaken out and the brood disposed of among weak colonies. This old chamber of brood and some bees having queen cells under way will soon mature a queen and later become as good as any colony.

Comb Honey.

Much more labor and skill is required in the production of comb honey than in extracted honey. In a great many locations some form of contraction is necessary to secure good work in the super. This is true of our own locality and sometimes it is almost impossible to get the bees to go to work in the supers. To remove some of the frames and replace them with wooden dummies invariably results in poor filling of the outside sections and getting them completed with the rest. For this reason all deep frame hives, if not failures, at least are clumsy. It will be seen, then, that it is better to contract from the top, retaining in this way the whole supering surface. With the sectional hive, removing all but one unit reduces the capacity of the brood chamber to the desired amount. This the queen will keep filled with brood, forcing the honey into the super. This single unit, holding the equivalent of about six and one quarter regular frames, is sufficient to maintain the strength of the colony during the main honey flow, after which another unit should be given for the bees to build up for winter. Obviously it takes but a moment's time with this hive to provide a very large brood nest or to contract to a very small one. Units should never be taken away, however, without giving their equivalent in supers, unless a swarm is desired.

Usually during fruit bloom most colonies will require more room. One unit of brood chamber filled with full sheets of foundation is given. This will be drawn out and occupied with honey and brood at the beginning of the clover flow. This is the unit, with its bright, new combs, that should be used when the brood chamber is reduced to one unit. Fancy, white comb honey would become more or less travel-stained if old brood combs were used

here. The excluder and super of section boxes are added and when this is about half filled another is inserted between. More are added as long as there is a prospect of their being finished, so that sometimes there are four or five on at once. Finished section honey should be removed from the bees as soon as completed. It sometimes takes but a few days to become soiled.

As stated previously, with the regular depth frame, bees are sometimes slow to enter the super, because of insufficient numbers or because of three or four inches of capped honey along the top bar of the brood frame, or because the honey flow is not plentiful enough. One or two sections of foundation should be removed and replaced with some that are partly drawn. These are called "Bait sections" and will generally bring about the desired result, and when the bees have once commenced to work in them there will be no further trouble.

Extracted Honey.

To produce extracted honey also requires a large force of bees in each hive. Weak colonies should be built up or united in advance so that all will be at full strength when the flow arrives. Either of the above hives can be used with supers the same size as the brood chambers or with shallow extracting supers. The shallow ones will probably be found the most satisfactory. After the combs are built, nine frames should be used in a ten-frame, or seven in an eight-frame hive. This results in thick, fat combs that are more easily uncapped. The excluder should be used.

When to Put on Supers.

To produce fancy comb honey, full sheets of thin or extra thin foundation should be used in the section boxes. These should be prepared and the supers ready in advance so that there will be no delay when they are needed. This will be about the middle of May if the season should be early and plenty of fruit bloom near by, or the first to the middle of June for clover. A good rule is to put on supers, either for comb or extracted honey when the combs begin to show white along the top bar and the brood nest appears crowded with bees.

The Extractor.

This is a machine with a revolving frame inside, used to remove the honey from the combs, and shown in figure 20. After the honey has thus been removed the combs are returned to the bees to be refilled. It is obvious that this is a great saving to the bees both in time and labor, which is very important during a rapid honey flow, and is the reason why liquid or extracted honey, as it is called, can be bought so much cheaper. An extractor is a good investment for a beekeeper with five or more colonies of bees. In setting the extractor it should be securely fastened in place and raised enough from the floor so that a pail will go under the gate.

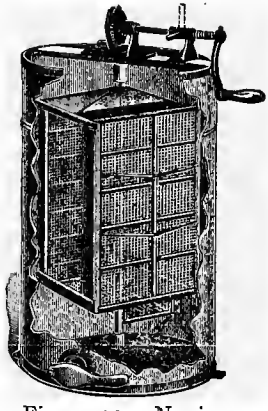


Figure 20. Novice non-reversible extractor. (After the A. I. Root Co.)

When the frames of honey are removed from the hive, they are taken into the extracting room, or some room that bees cannot enter and the cappings are cut off with a sharp knife (See figure 21). They are then put into the extractor, and after the honey has been removed from one side they are turned around and it is taken from the other.

Figure 21. Improved Bingham honey-knife. (After the A. I. Root Co.)

After the combs have been emptied, if the flow is over they should be stacked over one or more colonies, to be cleaned of what honey remains. This should be done at night so that they will be finished before daylight—when there is danger of robbers. At the end of the season all extracting combs should be put away secure from rats and mice. One mouse alone will do an immense amount of damage if allowed access to them. For protection from the wax moth, which sometimes makes its appearance, a few camphor balls can be used in each stack of combs.

Care of Extracted Honey.

Liquid honey as it is removed from the extractor should be strained into a deep tank and allowed to stand and settle for a

day or two. This allows small particles of wax to rise to the surface to be skimmed off. It is then bottled or put into cans as desired.

Honey and Its Uses.

Honey is made from a very thin nectar gathered from the flowers by the bees, and carried into their hives. It is so thin that sometimes it takes over two pounds of nectar to make one pound of honey. Different flowers produce different flavors and colors, as, for example, the very light and mild-flavored honey from linden or sweet clover, and the dark and strong-flavored honey from buckwheat.

The chemical analysis of honey shows that it is practically all invert sugar, though small proportions of fruit sugar and sucrose are present. Granulation occurs quickly in some honeys and takes place only after long keeping in others. Nearly all honeys granulate at the approach of cold weather and granulation is an indication of purity rather than of adulteration.

Honey is an excellent food, being almost pre-digested, and is especially recommended for children, invalids and consumptives. The common belief that honey, unlike sugar, can be used safely by diabetics seems not to be supported by facts.

Bakers have found that cookies and cakes, when sweetened with honey, will keep moist and palatable for a long time, and as it is in a sense a preservative, they will not mold. For this reason it is used in canning fruits, immense quantities of the cheaper grades being employed. It is used extensively by biscuit manufacturers and confectioners, one firm alone buying hundreds of tons each year.

For cooking recipes requiring honey, the reader should consult Farmers' Bulletin No. 653, U. S. Department of Agriculture, Washington, D. C.

Honey Plants.

Some of the principal honey and pollen plants of Connecticut, mentioned in about the order in which they commence to yield, are as follows:

Skunk cabbage, willow and elm trees, March and April. These are valuable for early pollen but furnish little nectar.

Maples; April, pollen and nectar.

Dandelion; May 10, pollen and some nectar.

Fruit bloom; May 15, pollen and nectar; when weather conditions are favorable, sometimes surplus honey.

Wild raspberry; June, pollen; nectar makes exceptionally fine table honey and usually yields plentifully.

Locust; May and June; some kinds yield heavily; honey light and of good flavor.

Clover; June 15. The clovers are the most important class of honey plants and include the common white, red, alsike, crimson and sweet clover. Alfalfa, although of the same family, secretes no nectar in this State. White and alsike are by far the most important and in some years produce large quantities of the finest table honey, which is recognized by its light golden color and delicate flavor.

Sweet clover; June until frost. This plant is not duly appreciated by our farmers, so is not sufficiently abundant in Connecticut to be an important honey plant. The honey is light colored, with a pleasant, spicy flavor, making it a delicious table honey. This plant is an exceptionally good forage plant, usually found growing in waste places or where the soil is too poor for other crops. Like the other clovers it requires lime for abundant growth, and when grown under favorable conditions can be cut two or three times a season. The hay is of fine quality, and is relished by horses and cattle.

Red clover; June. Secretes nectar abundantly, but on account of its corolla tubes being too long for honey bees it is more of a bumblebee plant. However, in times of drouth or in case of second growth when the tubes are shorter, it is sometimes worked extensively by honey bees.

Linden or basswood; July. This tree is seldom sufficiently abundant to become an important source of honey. The honey is very light and of fine flavor.

Sumac; July. Some kinds yield nectar freely. The honey is light and of fine flavor.

Goldenrod; September to frost. Honey is light, of good flavor when well ripened.

Wild aster; October till frost. Honey light and of good flavor, but granulates quickly.

Diseases of Bees.

Bees, like all other living things, are subject to diseases, the most common of which in Connecticut are the contagious bacterial brood diseases known as American and European foul brood. The latter is by far the most prevalent, having been found in every county and in some cases wiping out whole apiaries. These diseases, however, if taken in time, can be controlled, but if neglected are sure to cause loss and be a source of infection to surrounding apiaries. For this reason it is imperative that beekeepers should become acquainted with the appearance of these diseases and the methods of treatment so as to handle them intelligently. European foul brood, although much more contagious and rapid in spreading, responds better to treatment than the American foul brood. Dr. Phillips of the Bureau of Entomology at Washington describes the two diseases as follows:

"The presence of a particular disease in a colony of bees can be ascertained most reliably by a bacteriological examination, since the symptoms are somewhat variable. It is possible, however, to describe the usual manifestations of the diseases, and the usual differences, so that the beekeeper can in most cases tell which disease is present.

American Foul Brood.

"American foul brood is frequently called simply 'foul brood.' It usually shows itself in the larva just about the time that the larva fills the cell and after it has ceased feeding and has begun pupation. At this time it is sealed over in the comb. The first indication of the infection is a slight brownish discoloration and the loss of the well-rounded appearance of the normal larva. At this stage the disease is not usually recognized by the beekeeper. The larva gradually sinks down in the cell and becomes darker in color and the posterior end lies against the bottom of the cell. Frequently the segmentation of the larva is clearly marked. By the time it has partially dried down and has become quite dark brown (coffee colored) the most typical characteristic of this disease manifests itself. If a match stick or toothpick is inserted into the decaying mass and withdrawn the larval remains adhere to it and are drawn out in a thread which sometimes extends for several inches before breaking. This ropiness is the chief characteristic used by the beekeeper in diagnosing this disease. The larva continues to dry down and gradually loses its ropiness until it finally becomes merely a scale on the lower side wall and base of the cell. The scale formed by the dried-down larva adheres tightly to the cell and can be removed with difficulty from the cell wall. The scales can best be observed when the comb is held with the top inclined toward the observer so that a bright light strikes the lower side wall. A very characteristic

and usually penetrating odor is often noticeable in the decaying larvae. This can perhaps best be likened to the odor of heated glue.

"The majority of the larvae which die of this disease are attacked after being sealed in the cells. The cappings are often entirely removed by the bees, but when they are left they usually become sunken and frequently perforated. As the healthy brood emerges the comb shows the scattered sunken cappings covering dead larvae, giving it a characteristic appearance.

"Pupae also may die of this disease, in which case they, too, dry down, become ropy, and have the characteristic odor and color. The tongue frequently adheres to the upper side wall and often remains there even

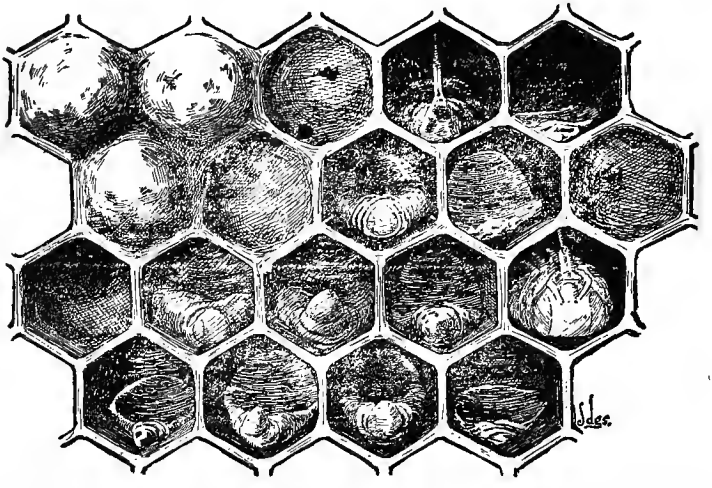


Figure 22. American foul brood: note the normal sealed cells; the sunken cappings, some showing perforations; the larvae and pupae affected by disease; the scales formed from dried-down larvae. Three times natural size. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

after the pupa has dried down to a scale. Younger unsealed larvae are sometimes affected. Usually the disease attacks only worker brood, but occasional cases are found in which queen and drone brood are diseased. It is not certain that race of bees, season, or climate have any affect on the virulence of this disease, except that in warmer climates, where the breeding season is prolonged, the rapidity of devastation is more marked. See figure 22.

European Foul Brood.

"European foul brood was formerly called 'black brood' or 'New York bee disease.' The name 'black brood' was a poor one, for the color of the dead brood is rarely black or even very dark brown. European foul brood usually attacks the larva at an earlier stage of its development than

American foul brood and while it is still curled up at the base of the cell. A small percentage of larvae dies after capping, but sometimes quite young larvae are attacked. Sunken and perforated cappings are sometimes observed just as in American foul brood. The earliest indication of the disease is a slight yellow or gray discoloration and uneasy movement of the larva in the cell. The larva loses its well-rounded, opaque appearance and becomes slightly translucent, so that the tracheae may become prominent, giving the larvae a clearly segmented appearance. The larva is usually flattened against the base of the cell, but may turn so that the ends of the larva are to the rear of the cell, or may fall away from the base. Later the color changes to a decided yellow or gray and the translucency is lost. The yellow color may be taken as the chief characteristic of this

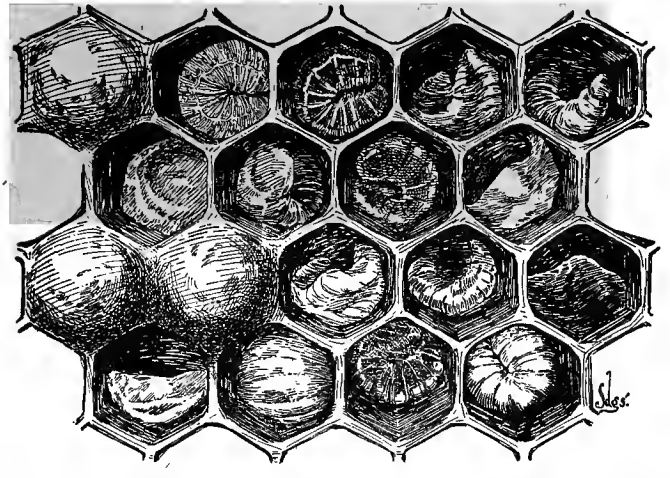


Figure 23. European foul brood: note the normal sealed cells; the larvae affected by disease; the normal larva at age attacked by disease; the dried-down larvae or scales. Three times natural size. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

disease. The dead larva appears as a moist, somewhat collapsed mass, giving the appearance of being melted. When the remains have become almost dry, the tracheae sometimes become conspicuous again, this time by retaining their shape, while the rest of the body content dries around them. Finally all that is left of the larva is a grayish-brown scale against the base of the cell, or a shapeless mass on the lower side wall if the larva did not retain its normal position. Very few scales are black. The scales are not adhesive, but are easily removed, and the bees carry out a great many in their efforts to clean house.

"Decaying larvae which have died of this disease are usually not ropy as in American foul brood, but a slight ropiness is sometimes observed. There is usually little odor in European foul brood, but sometimes a sour

odor is present, which reminds one of yeast fermentation. This disease attacks drone and queen larvae almost as quickly as those of the workers.

"European foul brood is more destructive during the spring and early summer than at other times, often entirely disappearing during late summer and autumn, or during a heavy honey flow. Italian bees seem to be better able to resist the ravages of this disease than any other race. The disease at times spreads with startling rapidity and is most destructive. Where it is prevalent a considerably larger percentage of colonies is affected than is usual for American foul brood. This disease is very variable in its symptoms and other manifestations and is often a puzzle to the beekeeper." See figure 23.

To the ordinary beekeeper the two diseases appear very much alike. "The sunken and perforated cappings, the reduction of the larva to a stringy, brown mass, the foul odor, and the dwindling of the colony, are the most noticeable indications of the foul brood diseases."

How Foul Brood Diseases are Spread.

Some of the means of spreading the infection are as follows:

By the bees:

1. Diseased bees entering wrong hives.
2. Robbing diseased colonies.
3. Eating honey that is infected.

By the owner:

4. Shifting combs from diseased colonies to healthy ones.
5. Using second-hand hives that have contained diseased colonies.
6. Promiscuous handling of healthy and diseased colonies without disinfecting hands and tools.
7. Exchanging places of colonies in diseased apiaries.

Treatment.

As it has been found that Italian bees are more immune to, or at least better able to resist the ravages of, European Foul Brood than other races, it is strongly recommended that apiaries be requeened with young Italian queens of good stock in either of the treatments given below. In the case of all weak colonies, or those showing 25 per cent. or more of diseased brood, it is best to shake the bees if in frame hives, or drum them out if in box hives, into new or disinfected hives containing full sheets of foundation. Good results are sometimes obtained where the colony is VERY

STRONG and the infection is SLIGHT, or less than above stated, by removing the old queen and introducing a young one of good Italian stock ten days later. This results in the cessation of egg-laying for several days, allowing the colony a chance to clean up the decayed matter. The dequeening method should not be used in the treatment of American Foul Brood, which can best be cured only by the shaking method. When treating by the shaking method, it is best to select a time when there is *some honey coming in*, as there is less danger of robbing and the colony will require no further feeding.

If, however, it is decided to treat immediately, and there is no honey coming in, it should be done towards night when few bees are flying, so as to avoid infecting other colonies. For this reason care should be taken not to spill or drop any honey where bees will have access to it. If no honey is coming in, feed a pint of sugar sirup each night for a week or until the bees are nicely started. Never use honey for feeding if it can be avoided.

Disinfection.

All tools, as well as the hands, should be washed thoroughly and the inside of the hive scorched with fire. A plumber's torch is best for this purpose but the hive can be moistened with kerosene oil and lighted, and when sufficiently scorched the fire can be extinguished with a blanket thrown over the hive. The combs should be melted into wax and the refuse burned or buried, and not left where bees can visit it.

Apiary Inspection in Connecticut.

Since 1909 apiaries in Connecticut have been inspected for foul brood diseases, as provided by Statute, the supervision of the work being in charge of the State Entomologist. Two inspectors are employed on a *per diem* basis, as follows: Mr. H. W. Coley, Westport, Inspector for Fairfield, New Haven, Middlesex and New London Counties; Mr. A. W. Yates, Hartford, Inspector for Litchfield, Hartford, Tolland and Windham Counties. Permanent records of these inspections are kept in the office of the State Entomologist at New Haven, and accounts of each season's work have been published in the Reports of this Station as follows:

1910, page 669; 1911, page 275; 1912, page 223; 1913, page 195; 1914, page 126; 1915, page 95; 1916, page 78; 1917, page 242.

Applications for inspection, or for advice about handling bees, may be made to either of the inspectors named above, or to W. E. Britton, State Entomologist, Agricultural Experiment Station, New Haven, Conn.

Publications on Beekeeping.

The following publications will prove useful to those who desire further information on apiculture.

BOOKS.

How to Keep Bees, by Anna Botsford Comstock. Doubleday, Page & Co., Garden City, N. Y., 1905. $1.00.

Beekeeping, by E. F. Phillips. The MacMillan Co., New York, N. Y., 1915. $2.00.

Productive Bee-Keeping, by Frank C. Pellett, J. B. Lippincott Co., Philadelphia, Pa., 1916. $1.50.

A B C and X Y Z of Bee Culture, by A. I. and E. R. Root. The A. I. Root Co., Medina, O., Revised Edition, 1913, $2.50.

BULLETINS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

The Honey Bee, by Frank Benton, Bulletin No. 1, New Series, Division of Entomology, 1896.

The Rearing of Queen Bees, by E. F. Phillips, Bulletin No. 55, Bureau of Entomology, 1905.

The Production and Care of Extracted Honey (Part I); Wax Moths and American Foul Brood (Part II) by E. F. Phillips, Bulletin No. 75, Bureau of Entomology, 1907.

The Treatment of Bee Diseases, by E. F. Phillips. Farmers' Bulletin No. 442, 1911.

Bees, by E. F. Phillips. Farmers' Bulletin No. 447, 1911.

Comb Honey, by Geo. S. Demuth, Farmers' Bulletin, No. 503, 1912.

Honey and Its Uses in the Home, by Caroline L. Hunt and Helen W. Atwater. Farmers' Bulletin No. 653, 1915.

STATE BULLETINS.

The Honey Bee, by Wheeler D. Wright, Bulletin No. 49, New York State Department of Agriculture, Albany, N. Y., 1913.

Beekeeping in Massachusetts, by Burton N. Gates, Bulletin No. 129, Massachusetts Agricultural Experiment Station, Amherst, Mass., 1909.

Some of the Essentials of Beekeeping, by Burton N. Gates, Bulletin No. 5, Massachusetts State Board of Agriculture, Boston, Mass., 1912.

The Honey Bee, A Guide to Apiculture in Canada, by C. Gordon Hewitt, Bulletin No. 69, Department of Agriculture, Ottawa, Canada.